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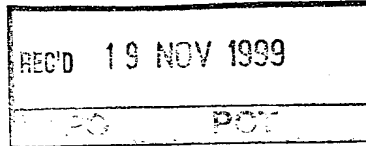
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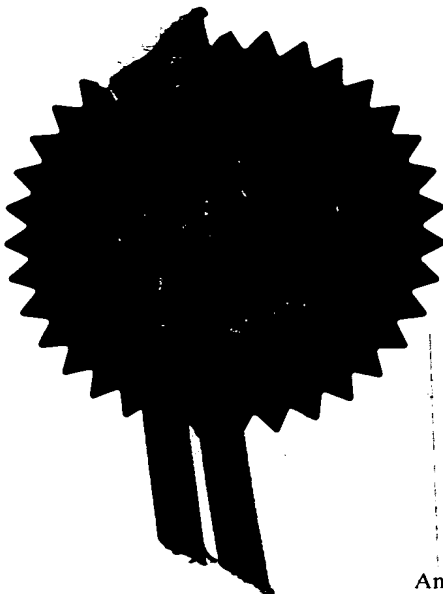
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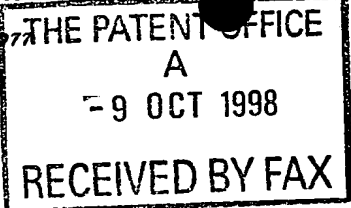
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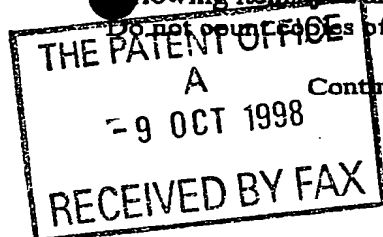
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1.	Your reference	PBA/D088262PGB	
2.	Patent application number (The Patent Office will fill in this part)	09 OCT 1998 9822019.7	
3.	Full name, address and postcode of the or of each applicant (underline all surnames) Patents ADP number (if you know it) If the applicant is a corporate body, give the country/state of its incorporation	JAMES HALSTEAD LTD P.O. BOX 3 RADCLIFFE NEW ROAD WHITEFIELD MANCHESTER M45 7NR UNITED KINGDOM 531467001	
4.	Title of the invention	FLOOR COVERING MATERIAL	
5.	Name of your agent (if you have one) "Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode) Patents ADP number (if you know it)	MARKS & CLERK SUSSEX HOUSE 83-85 MOSLEY STREET MANCHESTER M2 3LG 18004	
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Claim(s)

Abstract

Drawing(s)

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1

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Statement of Inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

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FLOOR COVERING MATERIAL

This invention relates to a material for use as a floor covering as well as a method for the production thereof.

Floor coverings based upon PVC are used extensively. Commonly they are produced by spreading a PVC plastisol onto a carrier substrate, often glass fibre, and then heat-curing the PVC. Such PVC floor coverings have the advantages of being inexpensive, easily coloured/patterned and combine longevity with ease of maintenance. However, a drawback of such floor coverings is that, although when dry they provide an adequate coefficient of friction (COF) to prevent users slipping, the COF can drop to dangerously low levels when the floor covering is wet, e.g. due to water carried by the feet of persons walking on the floor covering or because the floor covering is used in an environment where water may be spilt.

It is generally considered that a floor covering, when wet, should have a COF of at least 30 to prevent slipping. This value is usually achieved by one of the following methods.

a) An abrasive aggregate such as quartz, silicon carbide or corundum is incorporated into the wear surface during production of the floor covering. The aggregate provides a surface roughness which "breaks up" any water film thereon.

b) The texture of the floor covering is embossed to produce a high friction pattern.

c) A water absorbing filling agent such as cork is added as a filler during production.

Most manufactures have concentrated on the first method (i.e. (a)) to increase the COF. In this method the aggregate is embedded into the surface of the plastisol layer while it is still soft during manufacture of the floor covering. This ensures that the final floor covering has a roughened surface to provide the desired frictional properties. Furthermore, the aggregate can be used to give a decorative effect. For example, silicon carbide gives a shiny effect and quartz can be coloured.

However, when aggregates are used to increase the COF of PVC flooring there is a compromise between a higher COF and an increased maintenance effort. A floor covering with embedded aggregates tends to get dirty more quickly than an untreated floor covering as the aggregate removes dirt from footwear. Such dirt is difficult to remove from the surface of the flooring since it becomes embedded in the texture created by the aggregate. This effect is exacerbated by the claimed nature of the plasticised PVC formulation which tends to have a high affinity for dirt and grease. Quite often a rigorous cleaning regime is required for thoroughly removing the dirt and grease and inadequate cleaning can give rise to hygiene problems.

A further problem with plasticised-PVC type floor coverings is that they can stain easily. Thus, for example, oils, fats and greases lead to yellow staining of PVC, which can therefore easily be discoloured when used in a kitchen. Certain cleaning agents also contain dyestuffs that are picked up by the PVC and this is a further source of discoloration. The staining of PVC is obviously undesirable from an aesthetic point of view.

A further problem is that fats (e.g. as may be split in a kitchen) can soften the PVC leading to increased slippiness, undermining the effect of the aggregate.

In the case of PVC floor coverings which do not include aggregates, it is known to incorporate a surface barrier coating which prevents stains. The surface coating reduces the floor covering's susceptibility to picking up stains and dirt. The

coating typically lasts between 6-12 months and further lowers the frequency that the floor covering must be cleaned. However, such a coating cannot be used with PVC floor coverings that have aggregates embedded therein, as the coating covers the aggregate and reduces its efficacy.

It is therefore an object of the present invention to produce a floor covering that provides a sufficient COF, when wet, combined with ease of maintenance.

According to a first aspect of the present invention there is provided a floor covering material comprising a PVC layer and having aggregate embedded in the material for providing surface roughness wherein the material incorporates a barrier layer of polymeric material other than PVC fused into the upper surface of the PVC layer, the aggregate being exposed at the surface of the barrier layer.

The floor covering material of the invention thus incorporates aggregate providing surface roughness and a barrier layer bonded to the PVC layer. Surface roughness is achieved by ensuring that a portion of the aggregate material is exposed at the surface of the barrier layer. Thus, for example, the aggregate may be proud of the barrier layer or may have an exposed surface at the level of the barrier layer surface. The barrier layer serves to protect the underlying PVC layer from discoloration and softening as described above. The material of the invention thus has the two-fold advantage of slip resistance (as provided by the surface aggregate) and protection of the PVC layer. Moreover the composition of the barrier layer may be chosen to impart at least one further desired characteristic for the floor covering material, e.g. enhanced stain resistance, dirt release and/or heat resistance. By this means, desirable surface properties for the PVC flooring (e.g. enhanced dirt release, stain resistance etc) can be achieved without adversely affecting slip performance as occurs with conventional coating processes.

Furthermore provided that the aggregate is embedded in the PVC layer then slip resistance is maintained even if the barrier layer becomes worn away.

Preferably the barrier layer is of a cured polymer material but we do not preclude the possibility of the barrier layer being thermoplastic.

Preferably the barrier layer is at least as flexible as the underlying PVC layer so as not to crack during normal use and handling of the product. Preferably also the barrier layer is transparent or translucent.

The barrier layer may for example comprise a polyolefin, (co-)polyester, (co-)polyamide, polyurethane, phenol formaldehyde, epoxy or acrylic polymer or a mixture of the polymers.

It is also preferred that the floor covering material has an embossed surface. Such embossing serves to help retain the aggregate material in the surface of the material.

The aggregate material may for example be quartz, corundum, and/or silicon carbide.

According to a second aspect of the present invention there is provided a method of producing a floor covering material comprising

- (a) spreading a PVC plastisol on a substrate,
- (b) distributing over the surface of the plastisol a powder of a film forming, heat fusible polymeric material other than PVC,

- (c) distributing a particulate aggregate material over the surface of the plastisol, either simultaneously with or, preferably, subsequent to the distribution of the polymeric material, and
- (d) effecting heating to fuse the plastisol and convert the powder into a film

steps (b), (c) and (d) being effected such that aggregate is exposed at the surface of the film.

In step (a) of the above process, the substrate is for preference glass fibre although other materials may be used. The PVC plastisol may be spread onto the substrate using a knife-over-roller coating process. Typically the plastisol is applied to the substrate to a thickness of 1.5 to 3.5mm.

The powdered polymeric material used in step (b) may be a thermoplastic but is more preferably a material which becomes cured at a subsequent stage in the process. Thus, the polymeric material may be heat curable and become cured in step (d) of the process or may be a radiation (e.g. UV) curable system which is subjected to cross-linking is a step subsequent to (d).

The powder employed in step (b) should be one which is compatible with the PVC plastisol so that the polymer is converted to a film which bonds to the PVC layer in the floor covering. The film of the polymer should have a similar co-efficient of thermal expansion to the PVC layer. Given that the PVC layer is flexible then the film should be at least as flexible so as not to crack during normal use and handling of the product.

Steps (b) and (c) of the process may be effected simultaneously but it is however particularly preferred that step (b) be effected prior to step (c) in which case the powder may be softened (e.g. using a medium wave infra-red heater) to a semi-

molten state to allow more ready acceptance of the aggregate into the surface. Typically the amount of powder applied is 10 to 100gm². The powder preferably has a particle size below 200 microns. Further details of powders which may be used are given below.

For the purposes of step (c) of the above process, a wide variety of particulate aggregate materials may be used. Suitable examples include quartz, silicon carbide or corundum as conventionally used for providing surface roughness in floor coverings. The particle size of the aggregate is preferably in the range 0.5 to 1.00mm and is incorporated into the surface at a density of 50 to 200g m⁻².

In step (d), the heating may be effected in a drying oven using a temperature of 190-200°C. This will fuse the plastisol and melt the powder polymeric material to form a uniform film on the plastisol surface. If the powder is thermally cross-linkable then the cross-linking step (d) will be effected whilst the material is in the oven. If the powder is of a uv cross-linkable polymeric system then cross-linking may be effected in a subsequent step using uv lamps.

It is particularly preferred that pressure is applied to the surface of the material (e.g. by an embossing operation) after the heating operation (step (d)) but whilst the plastisol is still soft to produce a textured surface. This pressure application step assists in retention of the aggregate in the surface.

The powdered polymeric material used in step (b) may be a thermoplastic (thermofusible) material. Thermofusible materials flow to form a molten film on the plastisol and solidify on cooling. Examples of thermofusible materials which may be used include:

- a) polyester co-polymers (e.g. having a DSC melting range of 90-120°C, and a Melt Flow Index (MFI) of 15-40g/10 min under an applied load of 2.16 kg);
- b) co-polyamides (e.g. having a DSC melting range of 80-130°C, and an MFI of 15-95g/10 min under an applied load of 2.16 kg); and
- c) polyolefins (e.g. having a DSC melting range 100-135°C, and an MFI of 10-95 g/10 min under an applied load of 2.16 kg).

Examples of polyolefins which may be used include polyethylenes and ethylene-propylene copolymers.

Thermofusable polymeric coatings (e.g. of the type defined under (a)-(d) above) give improved soiling, chemical and staining resistance with no adverse effects on the slip resistance of the floor covering. The thermofusable polymers can either be used alone or blended to suit specific requirements.

It is however more preferred to use, as the polymeric material for step (b), a curable resin system. Such a resin system may be a thermosetting resin or a uv curable resin.

Thermosettable materials flow into a molten film on the plastisol substrate and are cross-linked by a heat activated cross-linking mechanism. Examples of thermosettable polymeric systems which may be used in the method of the invention include:

- a) epoxy resins, e.g. phenol formaldehyde resins and epichlorhydrin cured with aminic curing agents known in the art, such as benzyldimethylamine and dicyanamide;

- b) polyesters with hydroxyl or carboxyl end groups, cured with blocked isocyanates, e.g. caprolactam-isocyanate products;
- c) polyurethanes cured with blocked isocyanates; and
- d) acrylics incorporating epoxy resins and polyesters to allow curing with blocked isocyanates.

Thermosettable polymeric materials give the same benefits as those of thermofusible polymeric coatings but with the additional advantage of enhanced durability and staining resistance. The polymers can either be used alone or blended to suit specific requirements.

UV curable polymeric materials flow to form a molten film on the plastisol during step (d) and may cross-linked by the action of uv light subsequent to step (d). The following compounds can be used as UV curable coatings on the floor covering:

- a) unsaturated polyesters, cross-linked by free radical initiated polymerisation using curing agents known in the art, e.g. diacetoneacrylamide; and
- b) Bifunctional epoxy resins, cross-linked by cationic photoinitiated polymerisation using photoinitiators known in the art e.g. ferrocenium salts.

UV curable polymeric materials demonstrate similar benefits to those of thermoset polymeric coatings but with additional processing advantages in that the cross-linking reaction can be controlled separately from the plastisol fusion process. The polymers can either be used alone or blended to suit specific requirements.

A process in accordance with the present invention is illustrated, by way of example only, in the self-explanatory accompanying drawing.

CLAIMS

1. A floor covering material comprising a PVC layer and having aggregate embedded in the material for providing surface roughness wherein the material incorporates a barrier layer of polymeric material other than PVC fused into the upper surface of the PVC layer, the aggregate being exposed at the surface of the barrier layer.
2. A material as claimed in claim 1 wherein the barrier layer is of a cured polymeric material.
3. A material as claimed in claim 1 wherein the barrier layer is of a thermoplastic material.
4. A material as claimed in any one of claims 1 to 3 wherein the barrier layer is at least as flexible as the underlying PVC layer.
5. A material as claimed in any one of claims 1 to 4 wherein the barrier layer is transparent or translucent.
6. A material as claimed in any one of claims 1 to 5 wherein the polymeric material of the barrier layer provides enhanced dirt release and/or stain resistance in comparison to the PVC.
7. A material as claimed in any one of claims 1 to 6 wherein the barrier layer comprises a polyolefin, (co-)polyester, (co-)polyamide, polyurethane, phenol formaldehyde, epoxy or acrylic polymer or a mixture thereof.

8. A material as claimed in any one of claims 1 to 7 wherein the floor covering material has an embossed surface.

9. A material as claimed in any one of claims 1 to 8 wherein the aggregate is quartz, corundum, and/or silicon carbide.

10. A method of producing a floor covering material comprising

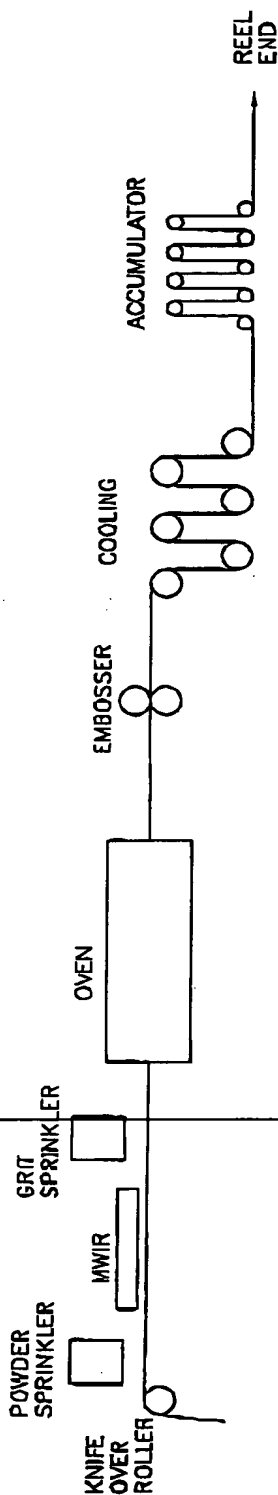
- (a) spreading a PVC plastisol on a substrate,
- (b) distributing over the surface of the plastisol a powder of a film forming, heat fusible polymeric material other than PVC,
- (c) distributing a particulate aggregate material over the surface of the plastisol, either simultaneously with or, more preferably, subsequent to the distribution of the polymeric material, and
- (d) effecting heating to fuse the plastisol and convert the powder into a film, steps (b), (c) and (d) being effected such that aggregate is exposed at the surface of the film.

11. A method as claimed in claim 10 wherein step (c) is effected subsequently to step (b).

12. A method as claimed in claim 11 wherein the fusible polymeric material is heated prior to distribution of the particulate aggregate material.

C0003248

HEAT CURED POWDER APPLIED TO WET PLASTISOL

PROCESS OUTLINE

HEAT CURABLE POWDER IS SCATTERED ONTO WET PLASTISOL. MWIR HEATERS LOCATED DIRECTLY AFTER THE SPRINKLER WILL SOFTEN THE POWDER SUFFICIENTLY TO STOP THE OVEN BLOWING THE POWDER AROUND. GRIT WILL BE APPLIED TO THE TOP OF THE SOFTENED POWDER. FULL FUSING OR CROSS LINKING WILL OCCUR IN THE OVEN. THE REMAINDER OF THE PROCESS IS UNCHANGED.

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